

REMARKS

Applicant has carefully reviewed the Office Action mailed January 16, 2008 and offers the following remarks.

Claims 29-38 and 52-55 were rejected under 35 U.S.C. § 112, first paragraph, for allegedly disclosing a single means claim (Office Action mailed January 16, 2008, p. 2). In particular, the Patent Office asserts that these claims recite only one means, a processor, configured to carry out a function. *Ibid.* Applicant respectfully disagrees. Claims 29-38 and 52-55 do not recite a single means. For example, claim 29 recites a system that comprises an input for receiving the signals; and a processor configured to determine pre-coding signal weights based on channel state information associated with the plurality of communication channels to provide proportional power allocation to the signals, and to apply the signal weights to the signals. Thus, claim 29 recites more than a single element. Claim 29 recites both an input and a processor. Likewise, independent claims 35 and 52 recite systems that comprise both an input and a processor. Accordingly, claims 29, 35, and 52, as well as the claims that depend from claims 29, 35, and 52 recite more than a single means. Thus, each of these claims, contrary to the assertion of the Patent Office, do recite additional elements besides a processor. As such, the Patent Office's rejection of claims 29-38 and 52-55 under 35 U.S.C. § 112, first paragraph are improper and should be withdrawn.

Claims 1-14, 16-27, 29-47, 49, 50, and 52-55 were rejected under 35 U.S.C. § 101 as being directed to non-statutory subject matter. In particular, the Patent Office alleges that these claims recite a method and apparatus that are disclosed as operating entirely in software and therefore the claims do not fall in one of the four classes of statutory subject matter (Office Action mailed January 16, 2008, p. 3). Applicant respectfully traverses.

First, Applicant notes that the Patent Office has not cited to any authority for the proposition that claimed subject matter does not fall into one of the four classes of statutory subject matter simply because it is capable of being carried out entirely in software. Applicant believes that such is not the law. 35 U.S.C. § 101 states : "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor" Claims 1, 17, 39, and 50 are directed to a method (process); claims 29 and 35 are directed to a system (machine or manufacture); and claim 52 is directed to a network element (machine or manufacture). These independent claims,

as well as the claims that depend from them, are clearly directed on their face to statutory classes of subject matter. Moreover, each of the independent claims recite steps or elements that produce a useful, concrete, and tangible result, and are thus directed to statutory subject matter. M.P.E.P. § 2106. In addition, claim 17 recites “receiving over a sub-group of a plurality of communication channels a subset of a plurality of signals.” Thus, claim 17 recites a tangible element (the communication channels), which is not entirely software. Claims 29 and 35 recite an input for receiving signals and a processor, which are tangible parts of a machine or manufacture, and are not carried out in software. Likewise, claim 52 recites a network element having an input configured to receive signals and a processor. A network element having an input and a processor is not something carried out entirely in software. Claim 50 recites “transmitting the channel state information to the transmitter,” which is not something carried out entirely in software.

Certain dependent claims include additional elements that are clearly tangible and are not carried out in software (see claim 2 (receiving channel state information from the receivers); claim 6 (implemented in a transmitter having M antennas); claim 12 (implemented at a transmitter in a multi-user MIMO system that provides respective $N \times N$ sub-MIMO channels from the transmitter to the receivers); claim 14 (wherein the transmitter has $M=4$ antennas); claim 22 (receiving the subset of the plurality of signals at respective antennas); claim 26 (implemented at a receiver in a multi-user MIMO system that provides an $N \times N$ sub-MIMO channel to the receiver); claim 31 (a plurality of antennas); claim 32 (implemented at a network element of a network, the network comprising a plurality of receivers, where each of the receivers comprises an input and a processor); claim 38 (a plurality of antennas); claim 40 (transmitting signals to the receivers); claim 44 (implemented in a MIMO system); claim 45 (transmitting a set of demodulation weights to each of the receivers); claim 49 (transmitting the plurality of demodulation matrices from a transmitter to the receivers and transmitting the weighted signals to the receivers); and claim 55 (a network element implemented in a closed-loop multi-user MIMO system, where the network element comprises a plurality of antennas and the MIMO system comprises a plurality of communication terminals)).

Moreover, the Specification never states that the claimed invention can be carried out entirely in software. The portions of the Specification cited by the Patent Office (page 14, line 19 through page 15, line 4; and page 26, lines 10-23) merely indicate that certain determinations

may be performed by a digital signal processor or other processor adapted to execute signal processing software. First, Applicant notes that the Specification merely indicates that these determinations (such as channel state determinations) may be performed by a processor; the Specification also indicates that other techniques are known and can be used. Second, the processors discussed in the cited portions of the Specification are pieces of hardware with software in them, so the invention is not carried out without some hardware. The hardware merely uses some signal processing software to perform certain tasks. Likewise, the beamformers discussed on page 26 can be implemented using signal processing software, but hardware is still required as well. The processor is based in the BTS 160, which includes a beamforming module, which is hardware. The Specification is simply stating that the hardware performs certain tasks in part using software. The fact that certain tasks may be performed in software does not make the claimed subject matter non-statutory.

Finally, what is discussed in the cited portions of the Specification is not the claimed invention. The cited portions merely determine that channel state determinations and the beamformers may be implemented using software, not that the claimed invention as a whole is carried out entirely in software. Accordingly, the cited portions of the Specification do not indicate that the claimed invention can be carried out entirely in software. For all of the above reasons, Applicant respectfully submits that each of claims 1-14, 16-27, 29-47, 49, 50, and 52-55 are directed to statutory subject matter. Therefore, the rejection of claims 1-14, 16-27, 29-47, 49, 50, and 52-55 under 35 U.S.C. § 101 should be withdrawn.

In particular, Applicant notes that claims 5, 12, 14, and 44-47 were rejected only under 35 U.S.C. § 101 and were not rejected based on any prior art. Thus, since the rejections under 35 U.S.C. § 101 are improper for the reasons set forth above and should be withdrawn, claims 5, 12, 14, and 44-47 now contain allowable subject matter.

Claims 1-4, 6-9, 13, 15-20, 22, 26-29, 31, 32, 34, 35, 38-43, and 48-56 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,873,606 B2 to Agrawal et al. (hereinafter "Agrawal"). Applicant respectfully traverses. For a reference to be anticipatory, the reference must disclose each and every claim element. Further, the elements of the reference must be arranged as claimed. M.P.E.P. § 2131. The requirement that each and every element be disclosed in the manner claimed is a rigorous standard that the Patent Office has not met in this case.

Claim 1 recites a method of processing signals to be transmitted to receivers on a plurality of communication channels, comprising:

determining pre-coding signal weights based on channel state information associated with the plurality of communication channels to provide proportional power allocation to the signals; and

applying the signal weights to the signals.

Agrawal does not teach “determining pre-coding signal weights based on channel state information associated with the plurality of communication channels to provide proportional power allocation to the signals,” as recited in claim 1. Agrawal does not disclose determining signal weights **based on channel state information**. Agrawal is directed to a rate adaptive transmission scheme for MIMO systems, which can transmit a variable number of data symbol streams, provide transmit diversity for each data symbol stream, and fully utilize the total transmit power of the system and the full power of each antenna (Agrawal, Abstract). In one method, more than one data symbol stream is received for transmission from a plurality of antennas and each data symbol stream is scaled with a respective weight corresponding to the amount of transmit power allocated to that stream. *Ibid.* However, the scaling weight in Agrawal is not based on channel state information. Agrawal discloses that the scaling factor is

$\sqrt{\frac{P_{tot}}{N_T}}$, the square root of the total transmit power that may be used for all the transmit antennas

divided by the number of transmit antennas (Agrawal, col. 3, lines 17-62). For the rate adaptive transmission scheme in Agrawal, a diagonal matrix is disclosed having diagonal entries that are indicative of the amount of transmit power allocated to the respective data symbol streams being transmitted (Agrawal, col. 4, line 49 through col. 5, line 3). However, this diagonal matrix disclosed in Agrawal is also not based on channel state information. The diagonal elements of the diagonal matrix is indicative of the amount of transmit power to use for an associated data stream and is not based on channel state information. Thus, the scaling factor in Agrawal corresponds to the transmit powers allocated to the respective data streams and is not based on channel state information. Since the scaling factor in Agrawal is not based on channel state information, Agrawal does not disclose “determining pre-coding signal weights **based on channel state information** associated with the plurality of communication channels to provide

proportional power allocation to the signals,” as recited in claim 1. Accordingly, claim 1 is not anticipated by Agrawal.

The Patent Office argues that the weights in Agrawal are based on the received channel response estimate and received signal to noise ratio (SNR) and cites to column 10, lines 4-17 of Agrawal (Office Action mailed January 16, 2008, p. 3). Column 10, lines 4-17 of Agrawal discloses that a channel response estimate is calculated and may be used to perform spatial processing or equalization at the receiver. A spatial processor may further estimate the SNRs of the recovered symbol streams and/or the received pilot signals. *Ibid.* However, there is no mention of the channel response estimate and the SNR estimates being used to calculate the scaling factor used in Agrawal. Thus, Agrawal does not disclose that the scaling factor is based on the channel response estimate, so Agrawal does not teach “determining pre-coding signal weights **based on channel state information** associated with the plurality of communication channels to provide proportional power allocation to the signals,” as recited in claim 1.

Claim 17 is a method claim that also recites that the pre-coding signal weights are based on channel state information. Claims 29 and 35 are system claims that also recite that the pre-coding signal weights are based on channel state information. Claim 39 is a method claim that recites as one step “determining a spatial coding matrix comprising a respective set of spatial coding weights for each of the receivers **based on the channel state information.**” Claim 52 is directed to a network element comprising as one element a processor configured to determine channel state information for each of a plurality of communication channels between the network element and the plurality of communication terminals and to determine a spatial coding matrix comprising a respective set of spatial coding weights for each of the plurality of communication terminals **based on the channel state information.** Thus, each of these independent claims is patentable for at least the same reasons set forth above with respect to claim 1.

Dependent claims 2-9, 13-22, 26-28, 31, 32, 34, 35, 38, 40-49, 51, and 53-55 are patentable based on their dependency from one of the independent claims.

In addition, certain dependent claims contain additional limitations that the Patent Office has failed to show are taught by Agrawal. For example, claim 3 depends from claim 1 and further recites “wherein the signal weights are elements of a pre-coding matrix P , and wherein determining further comprises determining the signal weights to enhance diagonal elements of a combined communication channel matrix $C = HP$, where H is a matrix of the channel state

information.” The Patent Office has failed to point out with particularity what in Agrawal is being equated to the claimed combined communication channel matrix $C=HP$. Claims 20 and 27 recite a similar limitation regarding a combined communication channel matrix $C=HP$. Thus, claims 3, 20, and 27 are patentable for this additional reason.

Applicant also respectively submits that the Patent Office has failed to show where each of the limitations of claims 6-9, 13, and 43 are found in Agrawal. The Patent Office merely alleged that Agrawal discloses a diagonal matrix, a transmit basis matrix, that each element is scaled with its associated weight, and off diagonal elements of the matrix will be forced to zero (Office Action mailed January 16, 2008, p. 4). Claims 6-9, 13, and 43 recite additional elements not addressed by the statements made by the Patent Office. Thus, the Patent Office has not made a *prima facie* showing of where each and every element of claims 6-9, 13, and 43 are found in Agrawal. The rejections of claims 6-9, 13, and 43 should therefore be withdrawn.

With respect to claim 16, Applicant respectfully submits that the Patent Office has made no showing as to the limitations recited in claim 16 as to subsets and sub-groups and decoding the received subset of weighted signals using inverses of the signal weights based on channel state information associated with the sub-group of the plurality of communication channels. Claim 16 recites: “at each of the receivers: receiving a subset of the weighted signals over a sub-group of the plurality of communication channels; and decoding the received subset of the weighted signals using inverses of the pre-coding signal weights based on channel state information associated with the sub-group of the plurality of communication channels.” The Patent Office has not indicated where in Agrawal these claimed subsets and sub-groups are taught. In particular, there is no indication as to where Agrawal teaches “decoding the received subset of the weighted signals using inverses of the pre-coding signal weights **based on channel state information associated with the sub-group** of the plurality of communication channels.” Claims 17-19 and 32 recite similar limitations regarding subsets and sub-groups. Thus, claims 16-19 and 32 are patentable for this additional reason.

Likewise, the Patent Office has not indicated what in Agrawal is equated to the claimed demodulation matrices and spatial coding weights recited in claims 50, 51, 55, and 56. Accordingly, claims 50, 51, 55, and 56 are patentable for this additional reason.

In a similar fashion, the Patent Office has not indicated what in Agrawal is equated to the claimed beamformers in claim 54. Accordingly, claim 54 is patentable for this additional reason.

Claims 10, 11, 23-25, 30, 33, 36, and 37 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Agrawal in view of U.S. Patent Application Publication No. 2005/0053170 A1 to Catreux et al. (hereinafter “Catreux”). Applicant respectfully traverses. To establish *prima facie* obviousness, the Patent Office must show where each and every element of the claim is taught or suggested in the combination of references. M.P.E.P. § 2143.03.

Claims 10 and 11 variously depend from claim 1 and contain all of the limitations of claim 1. Claims 23-25 variously depend from claim 17 and contain all of the limitations of claim 17. Claims 30 and 33 variously depend from claim 29 and contain all of the limitations of claim 29. Claims 36 and 37 variously depend from claim 35 and contain all of the limitations of claim 35. Thus, each of the dependent claims 10, 11, 23-25, 30, 33, 36, and 37 are patentable based on their dependency from the allowable independent claims. In particular, as discussed above, Agrawal does not teach or suggest “determining pre-coding signal weights **based on channel state information**,” as recited in the claimed invention. Catreux does not cure the deficiencies of Agrawal in this regard. Catreux is cited merely for its alleged disclosure of interference cancellation. Thus, the combination of Agrawal and Catreux does not teach or suggest each and every element of claims 10, 11, 23-25, 30, 33, 36, and 37. Claims 10, 11, 23-25, 30, 33, 36, and 37 are therefore patentable.

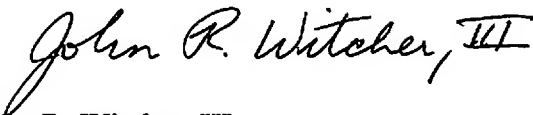
Claim 21 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Agrawal in view of U.S. Patent No. 5,828,658 to Ottersten et al. (hereinafter “Ottersten”). Applicant respectfully traverses. The standards for obviousness are set forth above.

Claim 21 depends indirectly from claim 17 and includes all of the limitations of claim 17. Thus, claim 21 is patentable based on its dependency from the allowable independent claim. In particular, as discussed above, Agrawal does not teach or suggest “determining pre-coding signal weights **based on channel state information**,” as recited in the claimed invention. Ottersten does not cure the deficiencies of Agrawal in this regard. Ottersten is cited merely for its disclosure of the Moore-Penrose pseudo-inverse matrix. Thus, the combination of Agrawal and Ottersten does not teach or suggest each and every element of claim 21. Claim 21 is therefore patentable.

The present application is now in condition for allowance and such action is respectfully requested. The Examiner is encouraged to contact Applicant’s representative regarding any remaining issues in an effort to expedite allowance and issuance of the present application.

Respectfully submitted,

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Date: May 15, 2008

Attorney Docket: 7000-611